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Feasibility of cleaner production for Vietnam rice processing industry

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Abstract

On the international market, Vietnam's rice value is quite low while production costs are too high, especially in energy costs. Moreover, wastes and pollution have become one of the most imperative issues of rice processing industry, leading to waste resources, increase costs, reduce product quality, and adverse impact on the working environment and habitats as well as the reputation of the enterprises. From analyzing the current state of Vietnam rice processing industry and studying Cleaner Production, this research would study the feasibility of cleaner production technology for Vietnam rice processing industry. A roadmap to implement the cleaner production technology would be suggested. A case study on a rice processing factory belonging to Vietnam Southern Food Corporation would be done. It shows that there is a potential demand on cleaner production and it is possible to implement for Vietnam rice processing industry.

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Keywords: Cleaner Production, Energy Management System, Rice husk charcoal, Rice processing industry

1. Introduction

Rice is one of top ten valuable commodities in term of Vietnam largest export turnovers. However, contributions of rice production in the economy remain limited and unsustainable. On the international market, Vietnam's rice value still is quite low while production costs are too high, especially in energy costs. Vietnam rice has not yet entered broader market such as European by strict rules on product quality and environmental requirements on rice production industry. According to the report of Vietnam Food Association (VFA), Vietnam rice export has decreases most dramatically among the key rice-exporting countries, which makes Vietnam rank 3 in 2013, behind India and Thailand. In comparison to a country sharing similar features in geography, natural sources and environment, Thailand, in the period of instability in world rice industry between 2010 – 2013, there were some certain points that Vietnam surpassed Thailand in export volume (in 2012) but still ranked behind in export turnover (at FOB price)*. Besides, the by-products of rice processing such as rice husk, bran have not been retrieved and used effectively.

Moreover, wastes and pollution have become one of the most imperative issues of rice processing industry, leading to waste resources, increase costs, reduce product quality, and adverse impact on the working environment and habitats as well as the reputation of the enterprises. On average, developed countries with strict environmental rules require spending about 1.5% GNP (Gross National Product) for activities and equipment to reduce industrial pollution [1]. Actually, the operation cost of these equipment often is 5 times higher than the installation cost. Focusing on waste treatment without paying attention to the original source of waste generation would add more costs but it could not reduce the amount of pollution. With the "foresight, anticipation and prevention" approach, Cleaner Production has become a solution which prevents the wastes by using effectively resources [2]. As a result, part material was transferred to finished products instead of excreting to the environment causing pollution. Therefore, cleaner production should be considered as a possible solution solving mentioned problems

* Data of Vietnam Food Association and Association of Thailand Rice Exporters

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in Vietnam rice industry at the moment – bad impact on environment and low rice values on international market.

2. The roadmap of Cleaner Production

"Cleaner Production is the continuous application of an integrated, preventive environmental strategy towards processes, products and services in order to increase overall efficiency and reduce damage and risks for humans and the environment." † The implementation process of cleaner production usually consists of 5 basic steps [2]:

(1) Planning and organizing the resources;

(2) Analysing the research object to identify the wastes and its characteristics;

(3) Proposing the possible solutions/methods;

(4) Studying the feasibility of the solution;

(5) Implementing the chosen solution.

However, cleaner production is not a one-time-project. In other to achieve the sustainable development and long-term benefits, the factory needs a system to maintain and improve continuously.

3. Cleaner production and Vietnam rice processing industry

This research was conducted on a rice processing factory belonging to Vietnam Southern Food Corporation as a case study. The commitment form the leader is very important, which could support establishing the cleaner production team. This team usually has the scale depending on the organization size. However, it should consists of members who have knowledge and skills as presented in Table 1.

Table 1 Cleaner Production Team Formulation

Member	**Required knowledge and skills**	**People in charge** (suggestive)
Team leader	Decision Making Techniques. Leadership. Project Management.	Vice director
Member 1	Environmental and energy use requirements in the processing of rice. Programs and applications related to environmental and energy consumption management. The concept of environmental management systems.	Factory manager
Member 2	The process of financial decision making. Risk management. Cost-benefit analysis of the selected solution.	Finance – accounting staff
Member 3	Rice production processes. The environmental measurement, control and assessment process. Industrial and systems engineering	Technical staff

After studying the processes and operations, the characteristics of energy consumption and wastes at rice processing plant are:

- Energy:
  - Electricity: All machine and equipment
  - Charcoal: Dyer
- Emission: CO_2
- Solid waste: Impurities, husk, rice bran, etc.
- Liquid waste: Very little
- Others: Noise, vibration

For energy issue, the factory has not managed the energy consumption process yet. Specifically, the plant power consumption has been much higher than the standard level of power consumption. The monthly reports show that the plant used 50 Kwh – 60 Kwh to produce 1 ton of raw material. Meanwhile, the standard level of power consumption is 23 Kwh – 30 Kwh‡.

About the solid waste, dust and bran still leaked into the air and dispersed into the environment during processing. Pipe End of Treatment for this type of contamination has been not yet effective. Regarding industrial emissions, noise and vibration have not currently affected the community because factories have been located in the suburbs away from residential areas. Factory pollution has been ignoring this type of pollution. However, with the high urbanization rate currently, ignoring the noise pollution and vibrations should pay attention on affecting on companies sustainable development.

In conclusion, urgent issues have increased force on the efficiency of energy consumption. Three goals setting up for a typical rice processing factory in Vietnam are shown in Table 2 [3].

Table 2. Matching between policy and objective of the plant

Policy	**Objective**
Ensure the compliance with the provisions and requirements related to energy management.	Complete the registration and labelling of energy under Circular 07 / 2012 / TT - BCT dated 04/04/2012 energy labelling for vehicles and equipment energy use of MOIT.

† The definition of United Nations Environment Programme

‡ Vietnam Southern Food Corporation

Continuously improve the energy efficiency of factories.	Discount 5 % of the total power consumption (kWh/ton raw material) through the application of energy management systems.
Raise the awareness of employees about energy saving.	All company employees are consciously contribute to the process of efficient energy use.

Many cleaner production tools or methods could be applied in rice processing industry. They could be classified into 5 categories as shown on Fig. 1.

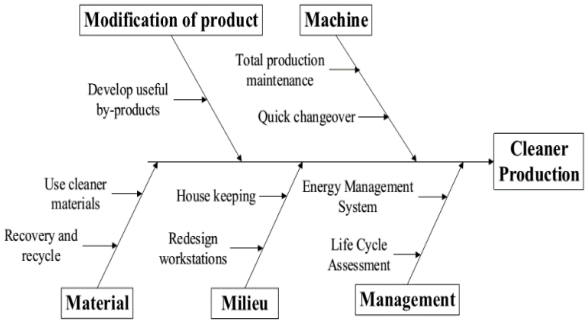

Fig 1. Classification of cleaner production tools

It is necessary to firstly conduct an effective management system before implementing tools or solutions of cleaner production. One of important management system is the energy management system (EMS) [4]. ESM is the foundation of supervision on the implement process of solutions, measurement of implement efficiency and plays as the prerequisite for continuous innovation. The next move is to continue implementing other relevant solutions related to products, working environment, machines and materials. The roadmap of implementing the cleaner production is sketched out and summarized as on Fig. 2.

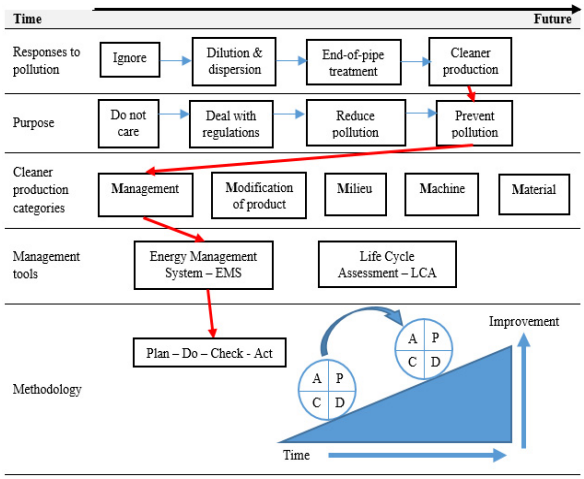

Fig 2. Roadmap of EMS implementation

In EMS, it is necessary to partition and monitor the power consumption of important equipment in other to promptly detect leaks and continuously improve the energy efficiency of factories. A form was suggested for the factory as shown in Table 3 to measure the equipment energy consumption [5].

Table 3 Energy consumption of each equipment

Equip.	Code	Power	Consump. Rate	Power consump.		Total
				Jan.	…	
Cleaner& De-stoner	NQ-1	Elect.	A1	B1		
Husker	NQ-2	Elect.	A2	B2		
Paddy Separator	NQ-3	Elect.	A3	B3		
Whitener	NQ-4	Elect.	A4	B4		
Rice Grader	NQ-5	Elect.	A5	B5		
Polisher	NQ-6	Elect.	A6	B6		
Total				C		

A, B and C is calculated by the following formula:

$$B\ (kWh) = A\ (kW) * Working\ hours\ (h) \quad (1)$$

$$C\ (kWh) = \sum B \quad (2)$$

For the grinding process, the plant also consumes large amounts of coal for drying raw rice. Meanwhile, by products of the process – rice husks are then sold cheaply or discharged into rivers. On average, 100 kg of paddy will generate approximately 20 kg of husk and the bulk density of which is 100-150 kg/m^3. In Vietnam, it is estimated that 1.5million tons of husks are disposed annually. Therefore, it is necessary to apply on-site recovery solution to produce useful and more valuable by-product – Rice husk charcoal.

According to the date provided by an engineering company in Mekong Delta, the cost of assembling lines of 7 rice husk charcoal making machine was around VND 1,079,700,000. With the average cost of producing rice husk per hour per machine was around VND 956,760, selling price of rice husk was around VND 1,100 per kilogram, and profit on one kilogram of rice husk is shown as the following earning curve on in Fig 3.

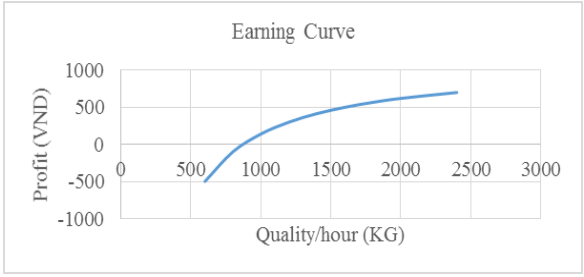

Fig 3. Earning curve of rice husk charcoal

4. Conclusions

Based on the above analysis, the implement of cleaner production technology in Vietnam rice processing industry is feasible and essential. The research sketched out a plan of generally implementing it into a typical rice processing factory, as well as analyzed the implementation of first cleaner production tools.

To implement the cleaner production technology into specific factories, it is necessary to analyse their current conditions to identify the main sewage current and to adjust properly implement tools. The most important issue playing significant role in the success of this technology implementation is to have leaders' commitment and participation of all factory staff. It is also vital to pursue that everyone in organization has aware of benefits of successfully implementing cleaner production technology and of authorizing them operate with the aim to create culture of cleaner production in entrepreneur.

In addition, each group of cleaner production tools relating to machines, humans, materials, working environment is able to open a new direction for research, feasibility analysis and implement into factories in the condition of Vietnam rice processing industry.

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